Development and Testing of a Green Monopropellant Ignition System

Completed Technology Project (2013 - 2017)

Project Introduction

The proposed experiment will demonstrate the potential of a novel micro-hybrid gas generator to thermally dissociate aqueous solutions of hydroxylamine nitrate (HAN). This ammonium salt lies within a class of ionic liquids (ILs) that have recently been investigated as alternative green replacements for hydrazine as a spacecraft propellant. The proposed research is directly aligned with two key elements of NASA's Space Technology Roadmap. 1) NASA TA01.1.4.2, Launch Vehicle Propulsion Technologies, Ancillary Propulsion Systems: Develop and mature ignition concepts that require low part count and/or low energy to be used as either primary or redundant ignition sources, and 2) NASA TA02.1.1.1, In-Space Propulsion Technologies, Liquid Storable Propellants: Evaluate alternate green propellants that allow thrusters to operate in pulse and continuous modes with these new propellants. Qualify propellants and components (valves, filters, regulators etc.) for spaceflight. While the primary purpose of this research is to support in-space propulsion, the technology could also be adapted for use as a main booster ignition system and as a reaction control thruster. A primary research objective is to demonstrate repeatable, consistent ignition of ionic-liquid-based propellants. With the current state of the art, propellants based on IL-solutions are notoriously difficult to ignite, and a cold-start capability does not exist. Existing catalyst beds used to dissociate the IL component of the solution must be pre-heated to greater than 350 C before firing. This shortcoming is especially disadvantageous for small satellite propulsion systems where energy conservation and volumetric efficiency are primary considerations.

Anticipated Benefits

While the primary purpose of this research is to support in-space propulsion, the technology could also be adapted for use as a main booster ignition system and as a reaction control thruster. A primary research objective is to demonstrate repeatable, consistent ignition of ionic-liquid-based propellants. With the current state of the art, propellants based on IL-solutions are notoriously difficult to ignite, and a cold-startcapability does not exist.

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Table of Contents

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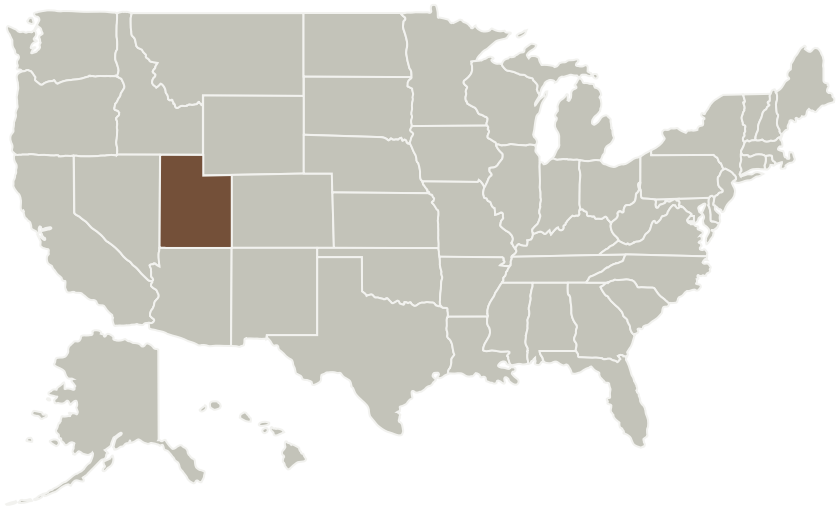
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Utah State University(USU)	Lead Organization	Academia Alaska Native and Native Hawaiian Serving Institutions (ANNH)	Logan, Utah

Primary U.S. Work Locations
Utah

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Utah State University (USU)

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

Stephen A Whitmore

Co-Investigator:

Daniel P Merkley

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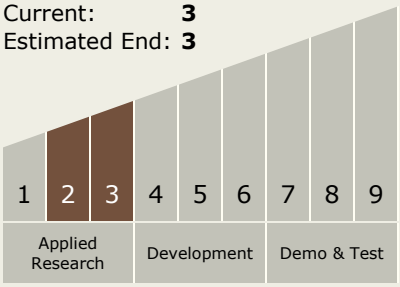
Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.1 Integrated Systems and Ancillary Technologies

Target Destination

Earth